



IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Application No. : 09/940,519 Confirmation No. : 5214
Applicant : Xiaoming GU
Filed : August 29, 2001
TC/A.U. : 3681
Examiner : Richard M. LORENCE

Docket No. : 280/50357
Customer No. : 23911

Title : WET MULTIPLATE CLUTCH

Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450

DECLARATION UNDER 37 CFR § 1.131

Sir:

I, Xiaoming Gu, hereby declare that:

I am the inventor of U.S. Patent Application Serial No. 09/940,519;

I had conceived the invention disclosed and claimed in this U.S. patent application, and the invention had been reduced to practice, before August 7, 2000;

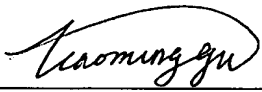
The conception and reduction-to-practice of the invention are evidenced by the attached Invention Disclosure (dates redacted) and its English translation. The Invention Disclosure was prepared prior to August 7, 2000, and was submitted to the inventor's employer, NSK-Warner K.K., for evaluation and for the preparation of Japanese Patent Application 2000-265111, the priority of which was claimed by the present application; and

Application No. 09/940,519
Declaration of Xiaoming Gu

All statements made herein of our own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine and/or imprisonment, or both under Section 1001, Title 18 of the United States Code, and that such willful false statements may jeopardize the validity of the application or any patent issuing thereon.

X.G.
02/25/05

February 25, 200⁵~~4~~



Xiaoming Gu

HIC:SZ:tlm
038769.50357US
350594

発明考案出願申請書

(兼 受理書)

| | | | |
|--------|--------|----|---------|
| 特 実 | 受 付 | 番号 | NW-5432 |
| | | 日付 | 年 月 日 |

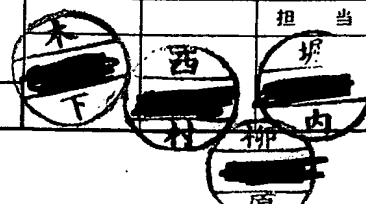
技術部長殿

殿

(申請 : 年 月 日)

所属部門
検 印

| | | | | | | | |
|---|--|--|---|----------------|-------------------|-------------|-----|
| A 発 明 考 案 者 記 載 欄 | (1) 発明考案の名称 | | 湿式多板クラッチ | | | | |
| | (2) 発明考案者 (事実上の発明者) ※印 代表者 内線 TEL | (社員番号) | 氏名 (フリガナ) | 所 属 | 住 所 (フリガナ) | | |
| | | (NO. 099002) | ※ 顧 曉 明 | | | | |
| | | (NO.) | | | | | |
| | | (NO.) | | | | | |
| | (3) 社外協力者 (単なる課題の提供者又は 発明完成後の実用化段階 における協力者は除く。) | 会 社 名 | | 代表者 (フリガナ) | | 住 所 (フリガナ) | |
| | | | | | | | |
| | | 協 力 関 係 | ①契約の有・無 ②共同研究 ③アイデア提供 ④その他 () | | | | |
| | | 共同出願理由 | | | | | |
| | (4) 権利の譲渡 | 出願担当窓口 | | 部署・役職名 () TEL | | | |
| | | | | | | | |
| | | | | | | | |
| (5) 出願の目的 | ①発明考案の独占 ②既発明の周辺固め ③他社出願の牽制 ④営業戦略 ⑤その他 () | | | | | | |
| | (6) 発明考案の概要 | 1) 成 因 ・ 動 機 | ①自発的独想 ②社内要求(上長の命令、他部門、クレーム対策) ③社外要求 ④その他 () | | | | |
| | | 2) 実 施 状 況 | ①着想のみ ②実験 ③試作 ④その他 () | | | | |
| | | 3) 発 表 | ①未発表 ②社内発表 () 付報告書No. () | | | | |
| | | | ③社外発表予定: 日付 ()、投稿誌 () その他 () | | | | |
| (7) 関連特許公報 | | 実開昭51-347, 実開昭50-40967, 実開昭50-40962 | | | | | |
| B 所 属 長 記 載 欄 | (8) 発明考案の評価 | ①技術程度 | 高 (中) 低 | ④完成度 | 十分、(ほぼ十分) 要改良、不十分 | | |
| | | ②効 果 | コスト低減、性能向上、増販、省力、量産化 | ⑤新規性 | (新規) 類似有、不明 | | |
| | | ③実 施 化 | 実施、(予定) 困難、未定 | ⑥製品価値 | (高い) 普通、低い | | |
| | (9) 出 願 の 可 否 | ① (可) ② 否 ③協議 | | | | | |
| | (10) 出 願 の 緩 急 度 | ①一任 ②出願希望時期 (理由 SPL-1スポット対策として密着に早急に提案したい) | | | | | |
| | (11) 外国出願の可能性 | ① (有) ②不明 ③ 無 | JOINT R&D 関連性 (有) (無) NO. (課題名) | | | | |
| | (12) 所 見 | 本考案は、高速・低流量下におけるセパレータプレート表面の、エアースポット抑制に非常に有効な手段であると考えます。 | | | | | |
| | C 技 術 管 理 記 載 欄 | 出願処理 | 優先、普通、保留 (調査、協議) | | 出願種別 | 特許、実用新案、要検討 | |
| | | 特記事項 | | | | | 担 当 |
| | | | JOINT R&D | | | | |



【書類名】 明細書（NW案）

【発明の名称】 湿式多板クラッチ

【特許請求の範囲】

【請求項1】複数のフリクシオンプレートとセパレータプレートを交互に配置した湿式多板クラッチにおいて、

隣合う前記フリクシオンプレートとフリクシオンプレートの間に前記セパレータプレートを複数枚配置したことを特徴とする湿式多板クラッチ

【請求項2】前記複数枚設置されたセパレータプレートは相互に離隔可能に配置されていることを特徴とする請求項1に記載の湿式多板クラッチ

【請求項3】前記複数枚設置されたセパレータプレートの間に更に薄い部材を介在させたことを特徴とする請求項1、2に記載の湿式多板クラッチ

【請求項4】前記複数枚設置されたセパレータプレートの相互に対向する面にコーティング又は表面処理を施したことを特徴とする請求項1乃至3何れか1項に記載の湿式多板クラッチ

【発明の詳細な説明】

【0001】

【発明の属する技術分野】

本発明は主に自動変速機に用いられる湿式多板クラッチに関する。

【0002】

【従来の技術】

図4に湿式多板クラッチの一例を示す。湿式多板クラッチ1は互いに相対回転するクラッチケース2とハブ3を備えている。そしてクラッチケース2にセパレータプレート11が、ハブ3にフリクシオンプレート5がスプライン嵌合によって軸方向移動可能に取り付けられている。そして、セパレータプレート11とフリクシオンプレート5は一枚ずつ交互に配置されている。

【0003】

【発明が解決しようとする課題】

しかしながら、上述の湿式多板クラッチを高速で摺動回転させるとヒートスポ

ットと呼ばれる熱変形が生じる。本発明はこのヒートスポットを抑制することを課題とする。

【 0 0 0 4 】

【課題を解決するための手段】

上記課題を解決するため本発明は、隣合う前記フリクションプレートとフリクションプレートの間に前記セパレータプレートを複数枚配置した。更に、この複数枚設置されたセパレータプレートは相互に離隔可能に配置し、また前記複数枚設置されたセパレータプレートの間に薄い部材を介在させたり、また前記複数枚設置されたセパレータプレートの相互に対向する面にコーティング又は表面処理を施した。

【 0 0 0 5 】

【発明の実施の形態】

セパレータプレートの厚さはヒートスポットに対して次式で表されるような影響があるものと考えられる。

$$\Delta t = \Delta T \cdot w \cdot \alpha \quad (\text{但し、})$$

Δt : ヒートスポットの高さ

ΔT : セパレータプレート表面の温度差 (ヒートスポット箇所と他の箇所)

w : セパレータプレートの厚さ

α : 線膨張係数 とする。)

つまり、セパレータプレートが薄いほどヒートスポットは発生し難い。また、ヒートスポット発生後摺動回転を続けると、このヒートスポット部分の面圧が高くなることから他の箇所に比べて温度がますます高くなるので、更にヒートスポットが大きくなる。

【 0 0 0 6 】

隣合うフリクションプレートとフリクションプレートとの間に配置するセパレータプレートは2枚とし、各々の厚さは従来のものの約半分とした。これは、トータルの熱容量をほぼ同じにするため、そしてクラッチケースに嵌合する爪の強度を確保するためである。

【 0 0 0 7 】

同じ箇所に使用する複数枚のセパレータプレートは離隔可能に配置した。これは、各セパレータプレートが完全に分離する場合はもちろん、セパレータプレートの間に薄い部材を介在させて接着固定した場合であっても薄い部材や接着剤の有する弾力によって微小離隔するような場合も含まれる。

【0008】

薄い部材については、各セパレータプレート間の断熱、制振、衝撃吸収等を行う作用があると推測される。ここで、制振は動力回転の振動を受けてセパレータプレートが震えることを意味し、衝撃吸収は各セパレータプレート間のクッションとしての作用を有するという意味であり、例えばセパレータプレートに微小凹凸があった場合に凸部の面圧を吸収し他方のセパレータプレートに対して全面均等に接触し易くなるということである。この薄い部材は、ゴム、ビニール、樹脂、或いはこれらの混合物からなる薄板や、不織布、織物、編物のような薄紙や薄布等薄いもの全てを包含する趣旨であるが、好適なものとしては各種ペーパー、シート、フィルム、ガスケット等が挙げられる。より具体的には、テフロンシート、ポリイミドフィルム、アラミドフィルム、フッ素フィルム、熱硬化性樹脂フィルム、ポリオキシメチレンフィルム、スーパーエンブラ繊維フィルム、ポリエチレンサルファイドフィルム、ポリエーテルイミドフィルム、ポリエーテルケトンフィルム、ポリエーテルサルフォンフィルム、カーボン繊維シート、シリカ繊維シート、マイカシート、石英ペーパー、がある。

【0009】

またコーティングについても上記薄い部材と同様の作用が有ると考えられる。このコーティング剤は上記薄い部材を接着する場合の接着剤とほぼ共通であり、具体的には、熱硬化性樹脂、エンジニアリングプラスチック、汎用樹脂、ポリマーアロイ、ブタジエンニトリルゴム、高弾性樹脂シートがある。

【0010】

表面処理はショットブラストやショットピーニングがあり、これによって、両セパレータプレート間に微小隙間が生じ、潤滑油を保持し易くなるという作用を有する。また、これらの表面処理は上記のような薄い部材を介在させている場合もそうでない場合も適用可能である。

【0011】

【実施例】

図1、図2に本発明の湿式多板クラッチを示す。尚、基本構造は上述の従来例のものとはほぼ同様であるので共通部分は同じ符号を用いる。湿式多板クラッチ1は互いに相対回転するクラッチケース2とハブ3を有しており、セパレータプレート11はクラッチケース2に、フリクションプレート5はハブ3に各々スプライン嵌合によって取り付けられている。図1の例（以下、第一実施例）では、セパレータプレート11が二枚重ねで互いにフリーな状態で取り付けられている。一方の図2の例（以下、第二実施例）では、二枚のセパレータプレート11の間にテフロンシート12が介在している。図3は図2のA側から見たテフロンシート12とセパレータプレート11の正面図である。

【0012】

図5に従来品、図6に第一実施例、図7に第二実施例の試験結果後の写真を示す。尚、試験条件は、

サイクル数：2

初期回転数：8100rpm

イナーシャ：0.196kg・m²

最大面圧：10kgf/cm²

スタート時の油温：100℃

潤滑（軸芯から）：0.18リットル/分

締結時間：約0.8s

である。写真を見れば分かるように各実施例のものは従来例に対して遥かにヒートスポットが抑制されていることが分かる。また、僅かではあるが第二実施例のものは第一実施例のものに対して更にヒートスポットが抑制されていることが分かる。

【0013】

【発明の効果】

本発明は以上を示す形態で実施され、ヒートスポットを抑制する効果がある。

【図面の簡単な説明】

【図 1】 本発明第一実施例の湿式多板クラッチの軸方向断面図

【図 2】 本発明第二実施例の湿式多板クラッチの軸方向断面図

【図 3】 図 2 の矢視 A を示す図

【図 4】 従来の湿式多板クラッチを示す図

【図 5】 従来例の試験結果後のセパレータプレートの写真

、 【図 6】 第一実施例の試験結果後のセパレータプレートの写真

【図 7】 第二実施例の試験結果後のセパレータプレートの写真

【符号の説明】

- | | |
|-----|------------|
| 1 | 湿式多板クラッチ |
| 2 | クラッチケース |
| 3 | ハブ |
| 5 | フリクシオンプレート |
| 1 1 | セパレータプレート |
| 1 2 | テフロンシート |

图 1

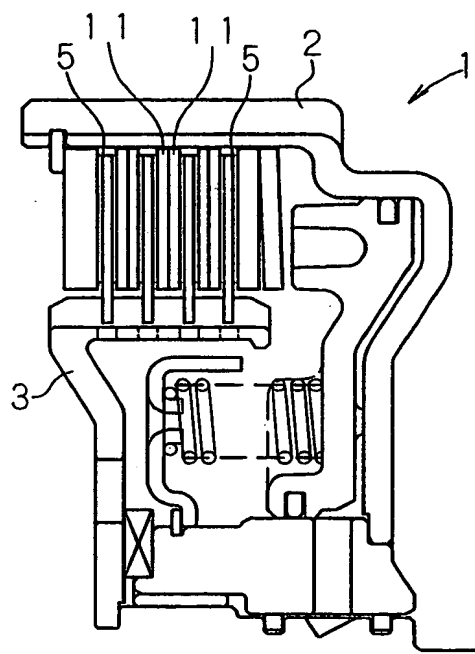


图 2

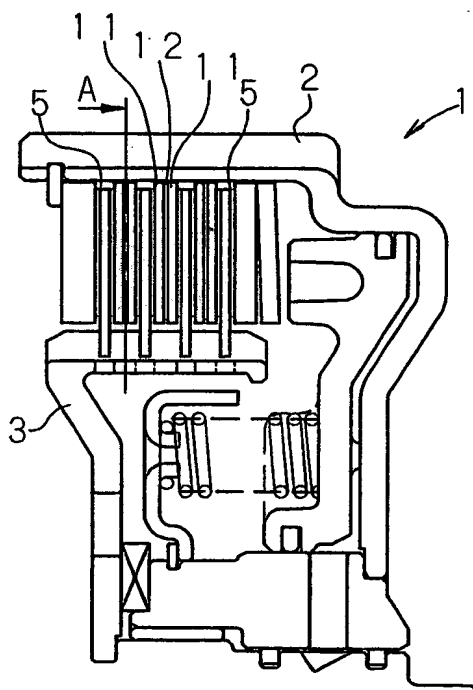


图 3

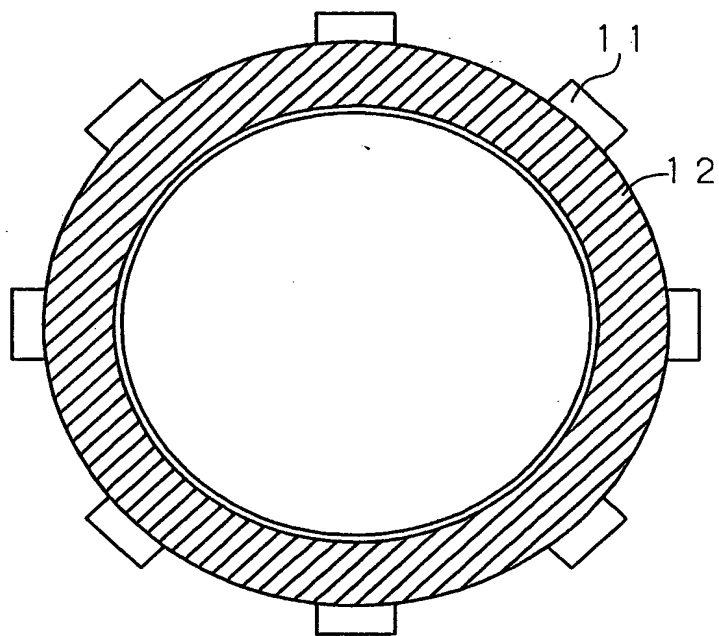
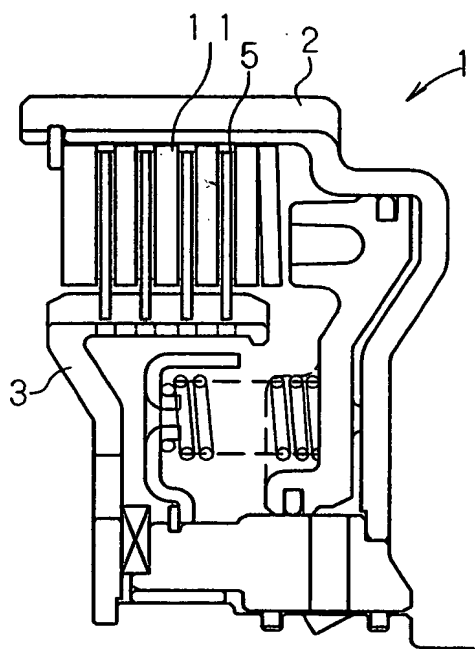


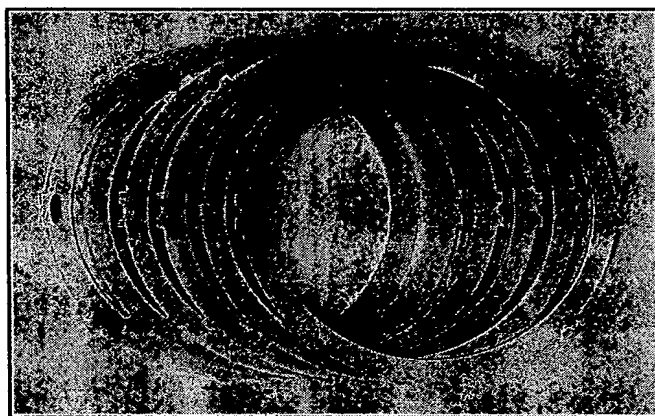
图 4



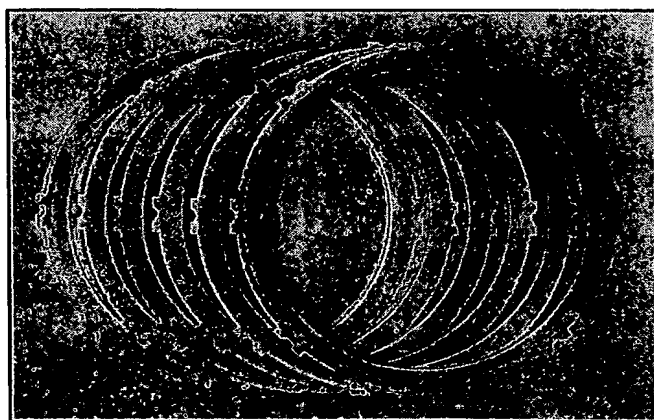
【図 5】



【図 6】



【図 7】



年月日 . . .

エヌエスケ-ワ-ナー株式会社 設

確かに受理致し、納期遵守にて処理します。

| | | | | |
|--|------------|-----------------------------------|------|--|
| 件 名 | ㊟・実・意・商出願 | ㊢ 鑑定, ㊣ 異議申立, ㊤ 情報提供 | | |
| | ㊠ 外国出願 | ㊡ その他 | | |
| 名 称 | 湿式多板クラック | | | |
| 発明 考 案 者 名 | 氏 名 (フリガナ) | 住 所 (フリガナ) | | |
| | 顧 暁 明 | 静岡県袋井市愛野2345番地 エヌエスケ-ワ-ナー株式会社内 | | |
| | | | | |
| | | | | |
| 備考欄: Ref. 実開50-40962, 実開50-40967, 実開51-347 | | | | |
| 納 期 | / . / . / | 審査請求 | 有, 無 | |

キ リ ト リ セ ン

整理No NW-5432

依 頼 票

年月日 . . .

砂川特許事務所 設

エヌエスケ-ワ-ナー株式会社

下記の納期迄に処理して下さる様依頼致します。

| | | | | | | | |
|--|------------|-----------------------------------|------|--|---------|--------|--------|
| 件 名 | ㊟・実・意・商出願 | ㊢ 鑑定, ㊣ 異議申立, ㊤ 情報提供 | | | 依 頼 担 当 | | |
| | ㊠ 外国出願 | ㊡ その他 | | | 西 村 | 柳 原 | 堀 内 |
| 名 称 | 湿式多板クラック | | | | | | |
| 発明 考 案 者 名 | 氏 名 (フリガナ) | 住 所 (フリガナ) | | | | | |
| | 顧 暁 明 | 静岡県袋井市愛野2345番地 エヌエスケ-ワ-ナー株式会社内 | | | | | |
| | | | | | | | |
| | | | | | | | |
| 備考欄: Ref. 実開50-40962, 実開50-40967, 実開51-347 | | | | | | | |
| 納 期 | / . / . / | 審査請求 | 有, 無 | | | | |

(注) 出願手続完了時には、依頼票・出願日を登録して通知願へ送付

DECLARATION

I, Tadashi Tsukamoto of 41-8, Utsukushigaoka 3-chome, Aoba-ku, Yokohama, Kanagawa 225-0002, Japan do solemnly and sincerely declare that I well understand both Japanese and English languages.

The translations attached hereto are true and accurate translations of a Proposal Form for Patent Application, an invention disclosure attached in the form of a draft specification to the Proposal Form, and an Order Slip.

I declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

This 22nd day of September, 2004



Tadashi Tsukamoto

Proposal Form for Patent Application

(and Approval Form)

| | | | |
|--------|----------|------|----------------|
| Patent | Received | No. | NW-53432 |
| U.M. | | Date | Month/day/year |

To: _____, Esq.

Manager, Technical Dept.

(Proposed: Year/month/day)

| | | | |
|---|---|--|---------------------------------|
| Supervisors' approval stamps | | KINOSHITA | SUZUKI, M. |
| WET MULTIPLATE CLUTCH | | | |
| (1) Title of the Invention | (Employee No.) | Name (with phonetic symbols) | Address (with phonetic symbols) |
| (2) Inventors (actual inventors) [* Representative inventor] Tel. Ext. # | (No. 099002) | * Gu, Xiaoming (sealed) | |
| | (No.) | (seal) | |
| | (No.) | (seal) | |
| (3) External collaborator(s) (exclusive of those simply provided the research theme or those collaborated during the stage of putting the invention into practical use after its completion) | Company name | Representative (with phonetic symbols) | Address (with phonetic symbols) |
| | Details of collaboration (1) Contracted/non-contracted, (2) Joint research, (3) Provision of idea, (4) Others () Reasons for joint appln. Our contact in connection with patent application Dept./Title () TEL (To be assigned/not to be assigned (Reasons:) | | |
| (4) Assignment of right | | | |

Columns A[to be filled out by inventor(s)]

| | | | |
|--|------------------------|---|---|
| Columns A [to be filled out by Inventor(s)] (Cont'd) | | (5) Objective of the application | (1) Monopolization of the invention, (2) Assurance of protection on peripheral technology of the invention already made, (3) Restraint to applications by other companies, (4) Marketing strategy, (5) Others () |
| (6) Outline of the invention | 1) Cause, motivation | (1) Own idea, (2) Internal requirement (supervisor's order, request from other department, countermeasure for customer's claim), (3) External demand, (4) Others () | |
| | 2) Status of practice | (1) Only idea level, (2) Experimented, (3) Trial manufacture, (4) Others () | |
| | 3) Release/publication | (1) Not released, (2) Internally released (Report No. dated M/D/Y), (3) External release scheduled for (M/D/Y) in (name of publication) (others:), (4) With/without subcontract on research or test (subcontracted on: M/D/Y) (subcontracted to:) | |
| (7) Related patent publication(s) | | JUM-A-51-347, JUM-A-50-40967, JUM-A-50-40962 | |

| | | | | | | |
|---|--|--|---|-------------------------|--|--------------------------------|
| Columns A (to be filled out by supervisor) (8) Evaluation of the invention | | (1) Technical level | High Medium Low | (4) Completeness | Sufficient, <u>practically sufficient</u> , further improvements needed, insufficient. | |
| | | (2) Advantages | Cost reduction, <u>improved performance</u> increased marketability, labor saving, mass productivity. | (5) Novelty | <u>Novel</u> , similar technology exists, not determined yet. | |
| | | (3) Possibility of practice | Practiced, <u>planned</u> difficult, not determined yet. | (6) Product value | <u>High</u> medium, low. | |
| | | (9) Approval/disapproval of application (1) <u>Approved</u> (2) Disapproved, (3) Further discussion needed. (1) Left to the discretion of Technology Management Section (TMS), (2) Hoped to be filed by: [REDACTED] (Reasons: Wishes to promptly propose to customers as a countermeasure for heat spots on separator plates). | | | | |
| (11) Possibility of foreign application(s) | | (1) <u>To be filed</u> (2) Not determined yet, (3) Not to be filed. | Relevant joint R&D | Exist/ <u>Not exist</u> | No. (title of the subject) | |
| | | This invention is believed to be a very effective measure for the prevention of heat spots on separator plate surfaces under high-speed and low-lubrication conditions. | | | | |
| Columns C (to be filled out by TMS) Processing of application Special notes | | Give priority, normal, hold (further search, discussion) | | Kind of appl'n | Patent, utility model, further study is needed. | |
| | | JOINT R&D | | KINOSHITA [REDACTED] | NISHIMURA [REDACTED] | Handled by HORIUCHI [REDACTED] |
| | | | | YANAGIHARA [REDACTED] | | |

[Document Name] Specification (Drafted by NW)

[Title of the Invention] WET MULTIPLATE CLUTCH

[Claims]

5 [Claim 1] A wet multiplate clutch with plural friction plates and plural separator plates arranged alternately each other, wherein between each adjacent ones of said friction plates, plural ones of said separator plates are disposed.

10 [Claim 2] A wet multiplate clutch according to claim 1, wherein said plural ones of said separator plates are disposed separably from each other.

 [Claim 3] A wet multiplate clutch according to claim 1 or 2, wherein between said plural ones of said separator plates, a thin member is additionally interposed.

15 [Claim 4] A wet multiplate clutch according to any one of claims 1-3, wherein said plural ones of said separator plates have been coated or machined at mutually-opposing surfaces thereof.

[Detailed Description of the Invention]

20 [0001]

[Field of the Invention]

 This invention relates to a wet multiplate clutch, which is useful primarily in an automatic transmission.

[0002]

25 [Prior Art]

 FIG. 4 shows one example of wet multiplate clutches. The

wet multiplate clutch designated at numeral 1 is provided with a clutch case 2 and a hub 3, which are rotatable relative to each other. Separator plates 11 and friction plates 5 are spline-fitted on the clutch case 2 and the hub 3, respectively, such that they are movable in an axial direction. The separator plates 11 and the friction plates 5 are alternately arranged one by one.

[0003]

[Object to Be Attained by the Invention]

However, thermal deformations called "heat spots" occur when the above-mentioned wet multiplate clutch is caused to slidingly rotate at high speed. An object of the present invention is to prevent such heat spots.

[0004]

[Means for Attaining the Object]

To attain the above-described object, plural ones of the separators are disposed between each two adjacent ones of the friction plates. Further, these plural ones of the separator plates can be disposed separably from each other, a thin member can be interposed between the plural ones of the separator plates, and/or coating or machining can be applied to mutually-opposing surfaces of the plural ones of the separator plates.

[0005]

[Embodiments of the Invention]

The thickness of a separator plate is considered have an

effect on heat spots as will be expressed by the following formula:

$$\Delta t = \Delta T \cdot w \cdot \alpha$$

where

- 5 Δt : Height of heat spots,
 ΔT : Temperature difference on the surface of the
 separator plate (i.e., a difference in temperature
 between the position of a heat spot and other
 position),
10 w : Thickness of the separator plate, and
 α : Coefficient of linear expansion.

The above formula indicates that a separator plate becomes more resistant to the occurrence of heat spots as it becomes thinner. If sliding rotation is continued after the
15 occurrence of heat spots, the bearing stress becomes higher at the positions of the heat spots so that the temperature rises much faster at the positions of the heat spots than at other positions. As a result, the heat spots become still greater.

[0006]

20 Two separator plates are disposed between each two adjacent friction plates, and the thickness of each of these separator plates is set at about a half of conventional separator plates. This is to make their total heat capacity substantially equal to the heat capacity of the conventional
25 friction plate, and also to assure providing spline tabs, said spline tabs being maintained in engagement with a clutch case,

with sufficient strength.

[0007]

Further, the plural separator plates used at the same position are disposed separably from each other. The term "separably" as used herein also includes such a case that, even when the separator plates are adhered and fixed with each other with a thin member interposed therebetween, the separator plates can slightly move owing to the elasticity of the thin member and/or an adhesive, to say nothing of such a case that the individual separator plates can completely separate from each other.

[0008]

These thin members are presumed to be effective for heat insulation, damping and impact absorption between the individual separators. The term "damping" as used herein means that separator plates vibrate upon receipt of revolving power. The term "impact absorption" means to act as cushions between the separator plates. When separator plates have asperities, for example, the term "impact absorption" means to absorb bearing stresses at asperities and to facilitate even contact of the separator plate with the other separator plate over the entire surfaces thereof. The term "thin member" as used herein should be construed to embrace thin plates made of rubber, PVC, a resin or a mixture thereof and any other thin members, for example, thin sheets and thin fabrics such as nonwoven fabric, woven fabric and knit fabrics. Preferred examples can include

a variety of paper, sheets, films, and gaskets. More specific examples can include TEFLON sheets, polyimide films, aramid films, fluorinated films, thermosetting resin films, polyoxymethylene films, super engineering plastic fiber films, polyethylene sulfide films, polyetherimide films, polyetherketone films, polyethersulfon films, carbon fiber sheets, silica fiber sheets, mica sheets, and silica paper.

[0009]

Further, coatings are considered to have similar effects as the above-described thin members. A coating material is practically the same as an adhesive useful upon adhering the thin members. Specific examples of the coating material can include thermosetting resins, engineering plastics, general-purpose resins, polymer alloys, butadiene nitrile rubber, and high-elasticity resin sheets.

[0010]

The term "machined" as used herein means to be machined by shot blasting or shot peening. As a result of this machining, a very small clearance is maintained between the separator plates, bringing about an advantageous effect that the holding of lubricating oil is facilitated. This surface machining is applicable no matter whether thin members such as those described above are interposed.

[0011]

[Examples]

Wet multiplate clutches according to the present

invention are shown in FIG. 1 and FIG. 2, respectively. It is to be noted that, as their basic constructions are substantially the same as the above-mentioned conventional example, like elements of structure will be identified by like numerals. Each wet multiplate clutch 1 is equipped with a clutch case 2 and a hub 3, which rotate relative to each other. Separator plates 11 and friction plates 5 are mounted by spline fitting on the clutch case 2 and the hub 3, respectively. In the example illustrated in FIG. 1 (hereinafter referred to as "the first embodiment"), two separator plates 11 are disposed side by side in a state independent from each other. In the example of FIG. 2 (hereinafter referred to as "the second embodiment"), on the other hand, a TEFLON sheet 12 is interposed between each two separator plates 11. FIG. 3 is a front view of the TEFLON sheet 12 and separator plate 11 as viewed from the side A in FIG. 2.

[0012]

Photographs of the conventional product, the first embodiment and the second embodiment after their tests are shown as FIG. 5, FIG. 6 and FIG. 7, respectively. The tests were conducted under the following conditions:

Number of cycles: 2

Initial revolution speed: 8,100 r.p.m.

Inertia force: $0.196 \text{ kg} \cdot \text{m}^2$

Maximum bearing stress: 10 kgf/cm^2

Oil temperature at the time of a start: 100°C

Lubrication (from the central axis): 0.18 L/min

Period of engagement: about 0.8 sec

As will be appreciated by taking a look on the photographs, it is understood that heat spots were prevented far more effectively in the wet multiplate clutches of the respective
5 embodiments than in the conventional example. It is also understood that heat sports were prevented more effectively in the wet multiplate clutch of the first embodiment than in the wet multiplate clutch of the second embodiment although the difference in effectiveness was slight.

10 [0013]

[Advantageous Effects of the Invention]

The present invention can be practiced in the above-described modes, and are effective for the prevention of heat spots.

15 [Brief Description of the Drawings]

[FIG. 1] An axial cross-sectional view of a wet multiplate clutch according to a first embodiment of the present invention.

[FIG. 2] An axial cross-sectional view of a wet
20 multiplate clutch according to a second embodiment of the present invention.

[FIG. 3] A view illustrating the wet multiplate clutch of FIG. 2 as viewed in the direction of arrow A.

[FIG. 4] A view illustrating a conventional wet
25 multiplate clutch.

[FIG. 5] A photograph of separator plates in the

conventional example after its test.

[FIG. 6] A photograph of separator plates in the first embodiment after its test.

[FIG. 7] A photograph of separator plates in the second
5 embodiment after its test.

[Legend]

- | | | |
|----|----|-----------------------|
| | 1 | Wet multiplate clutch |
| | 2 | Clutch case |
| | 3 | Hub |
| 10 | 5 | Friction plates |
| | 11 | Separator plates |
| | 12 | TEFLON sheets |

图 1

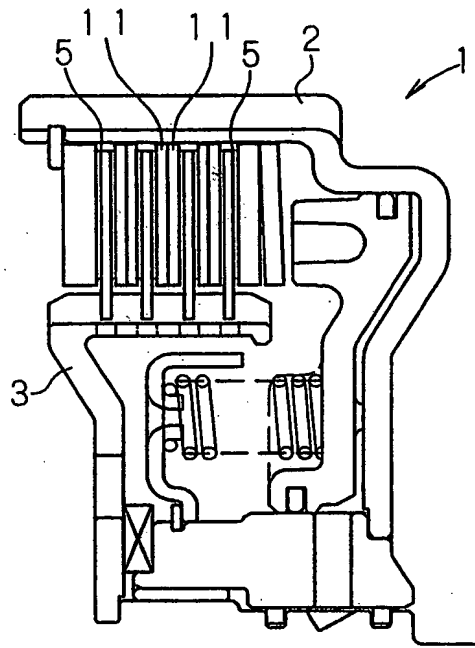


图 2

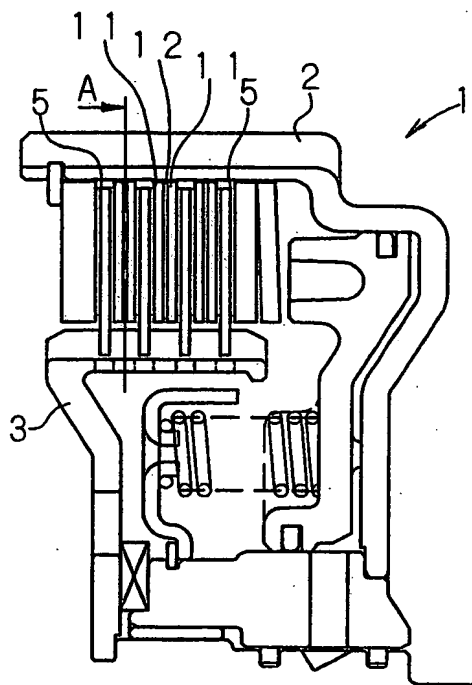


图 3

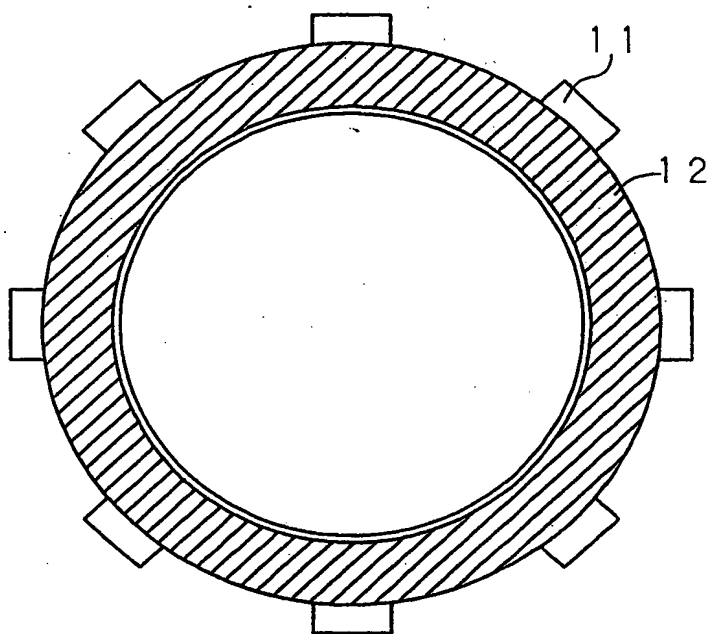
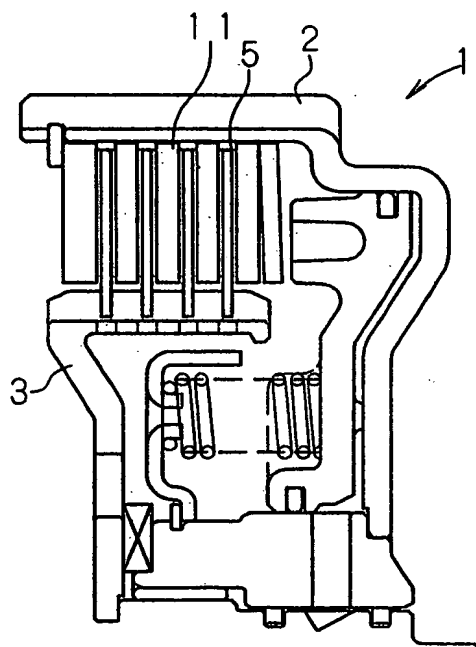
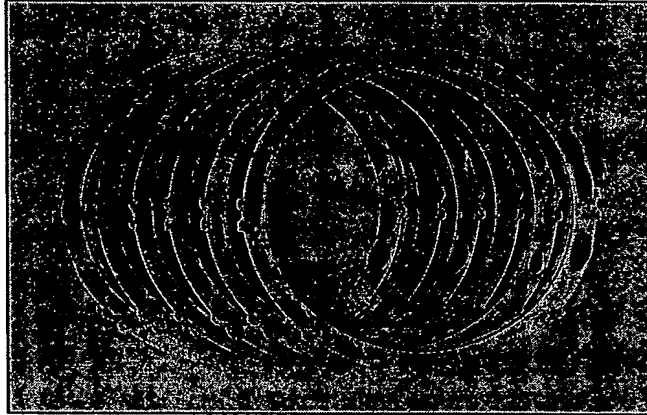


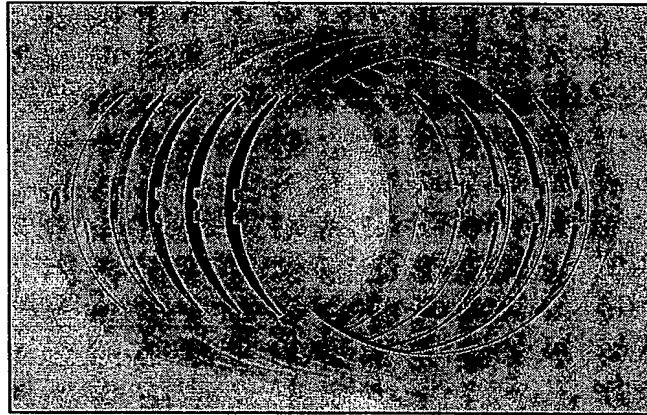
图 4



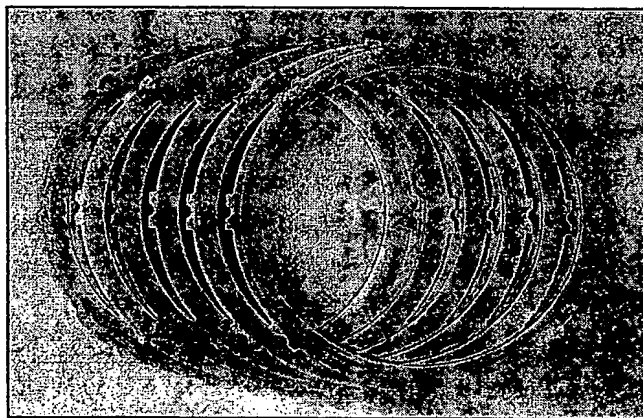
【図 5】



【図 6】



【図 7】



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|---|--|---|--|--|
| Ordered matter | Patent/U.M./ Design/TM application | ^B Professional opinion ^C Opposition ^D Presentation of information | | |
| | ^A Foreign application ^E Others | | | |
| Title | WET MULTIPLATE CLUTCH | | | |
| Inventor(s) | Name (with phonetic symbols) | | Address (with phonetic symbols) | |
| | GU, Xiaoming | | c/o NSK-Warner K.K. 2345, Aino, Fukuroi-shi, Shizuoka | |
| | ----- | | ----- | |
| | ----- | | ----- | |
| Remarks: Ref. UM-A-50-40962, UM-A-50-40967, UM-A-51-347 | | | | |
| Deadline | M/D/Y | Request for Examination | To be filed/ not to be filed | |

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NSK-Warner K.K.

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|---|--|---|---------------------------------|--|-------------|----------|--|
| Ordered matter | Patent/U.M./ Design/TM application | ^B Professional opinion ^C Opposition ^D Presentation of information | | | Ordered by: | | |
| | ^A Foreign application ^E Others | | | NISHIMURA | YANAGIHARA | HORIUCHI | |
| Title | WET MULTIPLATE CLUTCH | | | | | | |
| Inventor(s) | Name (with phonetic symbols) | | | Address (with phonetic symbols) | | | |
| | GU, Xiaoming | | | c/o NSK-Warner K.K. 2345, Aino, Fukuroi-shi, Shizuoka | | | |
| | ----- | | | ----- | | | |
| | ----- | | | ----- | | | |
| Remarks: Ref. UM-A-50-40962, UM-A-50-40967, UM-A-51-347 | | | | | | | |
| Deadline | M/D/Y; Should be strictly observed | Request for examination | To be filed/ not to be filed | | | | |

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